Governance Tools for Local Energy Autonomy

Anis Radzi and Peter Droege

Abstract Central to the very idea of 'climate change governance' is the aim of mitigation through the removal of fossil fuel content in energy supplies, the source of 85 % of all anthropogenic greenhouse gas (GHG) emissions (IPCC 2007). An understanding that all societal institutions are historically formed is also useful to this concept. Public administrative institutions, too, reflect their times and circumstances; to adapt them effectively, they must first be appreciated as social constructs, in turn serving to determine social reality. The past century of institutional evolution developed in a time of escalating and now near-total reliance on seemingly abundant fossil fuels and uranium, another non-renewable and destructive energy source. Energy issues were of little relevance at local level until the age of oil crises and climate change. Today, local and regional autonomy in renewable and broadly carbon-free energy supplies emerges as a central aim in the struggle to escape fossil fuel and nuclear dependency, with national and supra-regional renewable supply networks serving as support. This chapter examines major ways in which local communities can act through their government and administrative apparatus—effectively, efficiently and persuasively. We learn here from three successful attempts to gain substantial levels of local renewable energy autonomy.

Keywords Renewable energy autonomy · Energy-independent communities · Organisational change · Local government · Renewable energy institutions

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1 Context

Cities, towns and urban areas are fossil fuel-dependent constructs by definition, physically, culturally and in their governance structure. Change in both policy and practice is called for in this model, ranging from societal to technological agendas (Droege 2006, 2008, 2009). For the purpose of this discussion, it is important to recognise that the very organisation of public administrative systems, across executive, legislative and judicial branches of government, was shaped in an age when fossil fuels prevailed. Hence today's governance structures are not designed to cope with the provision of decentralised, locally sourced renewable energy, which is critical to the rapid and broad conversion, away from the current fossil-fuel suffused model based on remote sources, controlled by a relatively small number of all-powerful suppliers.

Consider the striking facts of the current dependence on fossil fuel: half of the commercial energy supplied worldwide is used for urban areas. The vast majority of this unsustainable resource flow consists of fossil fuel: almost all of global mechanised transport depends on petroleum (EIA 2006; IPCC 2007). The burning of coal and oil helped to boost atmospheric CO_2 concentrations by almost 40 % beyond their long-stable level of 280 parts per million. Given such shocking statistics, the immediate curtailment of new emissions and the biological re-sequestration of existing concentrations are of critical importance. The present occurrence of a global peak in the capacity to source fossil fuel cheaply only adds to the need for massive change: the staggering degree of global oil dependence at a time of peaking production capacity without any significant mitigating action in sight makes even the short-term prospects for global economic viability look grim (IEA 2010). Emergency actions are called for at all levels of society and economy, without precedence in the evolution of our civilisation. Central roles in this historical struggle fall to the governance of local communities: the very logic of renewable energy implies that a large degree of the required energy transformation is accomplished locally and regionally.

Local communities, no matter how small, can be purposeful and effective agents in the development of greater energy autonomy. For example, they can change their governance structure, develop and deploy special-purpose external organisations, or simply use their existing capacities more effectively and with a new purpose. And yet, although local governments have extraordinary powers of influence, they habitually use merely a fraction of this potential, especially in energy matters in which most have traditionally been passive stakeholders. Using all public administrative tools at their disposal, local governments can become effective in implementing even so-called 100 % renewable strategies—attaining full direct energy independence—using a set of five tools.[1]

[1] The loose framework of 'things government can do' is in part built on ideas developed at the Massachusetts Institute of Technology two decades ago. These related to the policy instruments available to local governments to improve urban quality and economic strength through cultural

Tales of three towns

We have chosen three small local communities—each with fewer than 5,000 inhabitants—to demonstrate the extraordinary power of control, change and purposeful innovation available to even small towns. The powerful tools presented here are those developed by three local authorities that have achieved autonomy in the supply of direct—non-embodied or imported—energy for all purposes, except for all of their transportation needs. Each tool is discussed in relation to specific projects undertaken by each of the local authorities, each with the expressed aim of escaping fossil—and nuclear—fuel dependency through locally generated renewable energy. This discussion concludes with a summary of the lessons learnt.

Wildpoldsried is a small municipality (population in 2009: 2,548) in Oberallgäu (www.sisby.de), an agricultural region in the Free State of Bavaria, Germany. The municipality meets all of its electricity and heating requirements from its own renewable resources based on wind power and photovoltaic systems for electricity, and on biomass for a local heating network. The village exports nearly three times its own electricity use as excess production into the power grid, realising healthy revenues, thanks to Germany's renewable energy feed-in legislation. Seeking to go beyond renewable energy redemption, it advocates the use of 'ecological' materials for building construction and has established a wetland waterscape project as a water remediation facility as an integral part of its 'ecological energy plan' (www.wildpoldsried.de). Its journey to energy autonomy commenced in 1999.

Güssing is a small town in the Burgenland region of southeast Austria, which had a population of 4,337 in 2010 (www.guessing.co.at); it is the administrative centre of the Güssing district. By implementing an energy plan based on the principles of energy conservation, the creation of value and environmental protection, it has been able to produce all of its own fuel and energy for heating, electricity and transportation from local biomass. In operation are a district heating system, a biomass-gasification facility, several biomass co-generators, a rapeseed oil refinery, and a photovoltaic and solar thermal plant. Profits earned from its energy services are reinvested in renewable energy projects, creating new jobs and attracting companies to the town and surrounding region. The community even generates renewable power for industrial production. It is the veteran of our three cases, having officially changed direction in 1990.

Samsø, an independent island municipality located 15 km off the Jutland Peninsula in Denmark, had a population of 4,300 in 2009 (www.energiakademiet.dk). In

(Footnote 1 continued)
development (Schuster et al. 1997). And for those interested in the theory of institutional change or evolutionary governance: in order to posit the possibility of purposeful change action, we found it useful to position thought and analysis between the system-critical ideas of 'new institutionalism' founded in part on the work of Peter L. Berger and Thomas Luckmann (1966), the more traditional view on institutional determination espousing the role of purpose and volition in action such as the thinking of Donald Davidson (2001)—going back to the writings of Dewey (1933) or Veblen (1915)—and the observations on learning organisations and change founded on reflective action presented by Donald B. Schön (1983).

1997, Samsø won a government competition to become a model renewable energy community. Today, the island produces all of its electricity and almost all of its heat from entirely renewable sources of energy—100 % of its electricity needs from wind power, and 75 % of its heating requirements from photovoltaics and biomass. It has achieved this by means of several land-based and offshore wind power plants and several heating plants via a district heating network. Its success was the result of a 'socially integrated energy development planning process', mobilising its community and relevant stakeholders to form energy development cooperatives (www.samsoe.dk). Its new planning processes were launched in 1997.

2 The 100 % Renewable Energy Governance Tool Kit

2.1 Regulation, Legislation and Standards

Although setting rules is a traditional role of government, they are not always applied with as purposeful a focus or conviction as might be necessary. For example, communities can strengthen and enforce building efficiency standards and mandatory renewable energy provisions for new buildings and renovations. They could even make full renewable energy self-sufficiency mandatory where climate, resource and national legal and pricing support mechanisms allow this. Regulations and standards can also be provided in cooperation with state and national governments, where municipal discretion to regulate is limited.

Despite being small, the three local governments have all embraced significant regulations for building and construction; area and land use planning; and renewable energy production management, monitoring and pricing. In Wildpoldsried, it is a requirement that energy performance certificates are issued for the retrofitting of old buildings and construction of new ones. The local government also recommends that new buildings are oriented to optimise solar gain by at least 15 °, and recommends angles for roof pitches between 26 ° and 32 °. The village's procurement policies also define energy and 'climate-friendly' purchasing principles, especially in the construction sector.

The municipality of Güssing not only mandates the use of renewable energy in all of its public buildings (see also Sect. 4 below), it also gives preference to renewable energy installations elsewhere, permitting the construction of larger-scale biomass and biogas plants on municipal land and facilitating contracts with local energy installers for small-scale renewable energy systems, and local farmers for the sourcing of locally produced biomass. Since consistency of supply is critical, the local authority insists that the construction of large-scale renewable energy installations is based on long-term financial contracts: facilities have to be operation for at least 15 years. Samsø also applies specific planning rules that assist renewable energy installation. In relation to wind power, landowner agreements were created which led to private owners of individual wind turbines

agreeing to allow space on their land to erect collectively owned turbines. By boldly advancing a district-heating network that runs on biomass, the local authority extended the infrastructure even to homes that had not yet agreed to become members of the new heating scheme. Although it was compulsory for residents living within the range of the existing district to agree to new heating contracts at a discounted rate, those connected to the new lines were given the option to join later, but with a considerably higher connection fee—a powerful incentive, as also discussed in the next section.

In all three local authorities, renewable energy conversion required a structured, accountable and reportable framework. The authorities of Wildpoldsried relied on municipal energy management guidelines set by the "Energie- und Umweltzentrum Allgäu" (Energy and Environment Center, EZA), a research and advisory facility that focuses on energy and environmental matters for the wider Allgäu region in which the village is located. These guidelines enabled the village authority to create its own energy inventory; manage and control its own energy supplies on a monthly basis; and even to regulate energy use by monitoring systems that could immediately notify users of spiking energy consumption. Municipal management costs were covered by local government funds, with support from the Bavarian Ministry of the Environment. In Güssing, renewable energy facilities are also guided by a network managed by an external institution, the regional competence 'centre' Renewable Energy Network Austria (RENET). The centre is operated by the local government's European Center for Renewable Energy (Europäisches Zentrum für erneuerbare Energien—EEE). Samsø's energy production is guided by distinct operational entities, also created by government: the various energy supply companies and the research and development centre of the Samsø Energy Academy based in the municipality.

Legislation established by national and state governments also greatly boosted the implementation of renewable energy in these municipalities. The EZA assisted Wildpoldsried in the deployment of a municipal energy management system based on the ISO 14000 Environmental management standard; and advised the municipality on issuing energy certificates for various types of buildings based also on a German industrial standard (DIN V 18599 Energy performance of buildings standard). These provisions are designed to work together to regulate electricity and heat consumption as well as control local renewable energy supply. Development and pursuit of these standards are structured within an overall policy framework, provided by the local authority's Agenda 21 strategy. The policy represents a response to the Bavarian Climate Protection Policy, conceived by the state government, which aims to double the share of renewable energies in the production of primary energy to 16 % by 2020 and fund low-energy construction and the energetic refurbishment of buildings. The policy also outlines an integrated climate protection concept specifically for municipalities, which includes directives on providing financial assistance to all energy-related areas of the municipality (Free State of Bavaria 2007).

Güssing's success in becoming an energy-autonomous community was published in the State Energy Concept 2003, issued by Burgenland Energy Agency. It

includes revisions to its Housing Assistance Act 2005 and other state laws, which mandates the promotion of renewable energy sources, the promotion of new technologies for 'green energy' production and the increase of energy efficiency. The Act stipulates that there should be subsidies to contribute up to 30 % of the cost of a range of energy installations, such as water pumps, thermal solar installations for hot water, heat pumps, solar thermal systems, household central heating systems with biomass and connection to biomass-powered district heating network. It also contains guidelines for the promotion of businesses in the fields of environment, ecology and energy.

Samsø's success was also driven by regulations at different government levels. Its initial impetus to become energy autonomous was triggered by a national Renewable Energy Island Competition in 1997—the original brief was based on recommendations of the national government's Energy 21 Plan (1997), aiming at 35 % of gross energy being supplied renewably by the year 2030 for Denmark as a whole. Since then, the conception of the national government's Renewable Energy Act has articulated the deployment of a range of renewable energy technologies in all municipalities. One example is the provision of areas reserved for wind power generation in municipal plans. The Act also stipulates the various subsidies available, such as the "green scheme" grant, which finances activities carried out by municipalities to encourage local community acceptance of renewable energy.

2.2 Carrots and Sticks

Incentives—rewards, or 'carrots'—for taking efficiency measures and developing renewable energy installations, or for setting up renewable energy service companies (RESCOs), can be provided through taxation and pricing policies.

The feed-in tariff is a guiding model used in over fifty countries at national or state level. Feed-in tariffs provide a pricing, or market, incentive, setting the price per kilowatt-hour (kWh) that an electricity utility has to pay to a private, independent producer of renewable power fed into the grid. All three local authorities discussed in this chapter have benefited from their national feed-in tariff systems. The German feed-in tariff for example, enabled Wildpoldsried's wind and solar electricity assets to secure income for the local community by generating over 100 % of its own demand in renewable power annually (321 % in 2011). Similarly, the cost of energy from the renewable energy plants in Güssing has increased in competitiveness against conventional fuels due to a high feed-in tariff. In Samsø, community stakeholders co-operatives or private wind turbines are rendered more economically viable thanks to the guarantee of a generous 10-year feed-in tariff for wind power.

But our communities also deploy renewable energy carrots of their own: in Wildpoldsried, for example, the installation of wind turbines and other renewable energy technologies above a certain scale are eligible for more favourable planning standards. Reimbursements are also provided for the construction of zero

energy or energy neutral buildings. In Güssing, government lands are earmarked for renewable energy plants and planning approvals are fast-tracked for their construction. In Samsø, ownership schemes outline provisions that allow the general public to reserve future shares in wind turbine sites, within areas which are privately owned. (PlanEnergi and Samsø Energy Academy 2007)

All three energy-autonomous communities were supported by financial incentives provided at almost every level of government, from the local, regional and national bodies to the European Union. Financial investments also came from many private companies and industries. In all cases, a comprehensive energy and financial model helped secure further grants.

The energy projects in Wildpoldsried were largely funded by the local community co-operative and private individuals. Financial asistance from the regional and state governments enabled the municipality to subsidise programs such as providing households access to energy consultants, or share the costs of thermographic imaging and subsequent advice on insulation options for households according to the mapped heat losses in buildings. In Güssing, research subsidies and favourable leasing arrangements were provided for renewable energy companies who wished to set up premises in the local area. Fees charged to buildings connected to the district heating network helped guarantee on-going finance of the renewable energy facilities. In Samsø, grants from the Danish Energy Authority helped fund free energy appraisals for homeowners and subsidise investments into energy savings installations across the community such as the subsidy program to help pensioners make home improvements to save energy. By acting as guarantor for grant application to banks for the district heating stations and wind turbine installations, Samsø local authority was able to secure a very low interest rate for its community.

Energy awards won were also used as a financial leverage, besides boosting general interest in renewable energy in the community. The Bavarian State Ministry of the Environment and Public Health (StMUG) promoted Wildpoldsried's participation and the eventual award of the European Energy Award® (eea®). The fact that Güssing won Energy Globe and Eurosolar awards gave it credibility in securing funds for further research. Samsø's award-winning 10-year 'Renewable Energy Island' plan was behind its success in several funding applications. And labels and thematic strategies such as ecotourism have boosted the image of these communities.

Raw material for authentic renewable energy production is sourced locally. Incentives are therefore critical to maintaining the availability of local material and human resources. For example, Wildpoldsried supports only the use of wood pellets, which are produced from waste wood by the wood industry within the region. Güssing guarantees stable energy prices for local farmers as bioenergy croppers through the use of 10-year contracts at a fixed price, generally above market values, enabling farmers to generate income, both in the raw material supply to the plants and in the energy delivery from them. Samsø meanwhile stipulates that straw and wood chips for the district heating stations should be produced only by local farmers.

Incentives were also accompanied by certain disincentives. In all three local authorities, the presence of an infrastructure for district heating powered by bio-energy installations helped motivate communities to change their existing systems. It helped them to visualise both heating price reductions as well as a dramatic lowering of emissions from oil boilers. In Güssing and Samsø, all homeowners whose houses were already connected to the district-heating network were asked to voluntarily sign up by a certain date and to pay a very small membership fee. However, in order to provide a disincentive to postponing this change, the cost after that date was dramatically raised—in Samsø from USD 20 to nearly USD 8,000 (www.energiakademiet.dk).

2.3 From Information to Knowledge Networks

Local communities can boost the degree to which they provide information and advice. Advisory services to residents, local industries and incoming companies are an important change driver within all three local authorities. In Wildpoldsried, the community-funded Energy Advice Centre (EZA) provides professional, independent advice on energy conservation and the increased use of renewable energies by local households. With the help of EZA, building managers are supported and trained in local energy management; and, in cooperation with the regional energy provider, the "Allgäu Überlandwerk" (AÜW), green power certification, energy consulting for households and businesses, power meters for hire as well as regular energy-saving recommendations are among the regular services available. Similarly, the EEE Association in Güssing, established by its local authority, not only manages the various renewable energy facilities operationally, but also provides the framework for research and development in renewable energy and incentives to enlarge the knowledge network to include industries and suppliers. The Samsø Energy Academy also supports expertise and promotes its renewable energy projects, providing assistance for further research and development. The free technical advice on renewable energy installations provided by the municipality is greatly appreciated by the citizens of Samsø. .

Community information networks are essential in all three communities: the local energy facilities require not only local manpower and resources, but also insight into the means of implementation and management. In the three communities, an awareness of the energy plan, goals, policies and projects was essential for all stakeholders, from the municipal councillors and employees themselves to the local resident community, and private companies and industry. New concepts were to be communicated early, and often long before any project was implemented or facility constructed. In all three towns, working groups consisted of local citizens whose responsibility was to understand and communicate the resources available or the technologies selected by the local authority. This also meant informing the rest of the population about initiatives through public hearings, and creating acceptance of the proposed implementations: sometimes to

directly lobby and collect signatures. With the support of the local government, these supporters were even involved in looking for other potential investors.

Engagement and cross-fertilisation of ideas with other communities takes place through established frameworks, such as the European Energy Award® and EZA in Wildpoldsried; the EEE Association in Güssing; and the Samsø Energy Academy in Samsø. All play host to many visiting groups from around the world. In the case of Güssing, the Association's growing reputation as a leading centre for renewable energy research has attracted solar energy companies interested in powering their manufacturing facilities with renewable energy, removing embedded dirty energy content. The success of the EEE Association in transforming the municipality into a centre for energy autonomy has attracted local government delegations from all over the world. The Samsø Energy Academy also plays host to many research and governmental delegations and represents Denmark in promoting its renewable energy agenda abroad. They have created a communication platform to encourage innovation and the dissemination of ideas through 'cultural intelligence gathering', recognising not only local traditions and culture but knowledge brought in from international partners (www.energiakademiet.dk).

Local information centres advise households and companies on energy conservation and the installation of renewable energy technology in all three local authorities. Wildpoldsried's Energy Advice Centre helps run 'energy days' in schools. The local energy projects are presented on the municipal website, and the community's energy initiatives are documented in the district newspaper and in professional journals. In Güssing, a motel has been built near the EEE Association, heated and powered exclusively by renewable energy, and there are guided tours of its various renewable energy installations. In Samsø, the promotion of renewable energy by public campaigns and local efforts has helped increase the rate of renewable energy installations, such as solar installations in ports, at a youth hostel and the local camping ground.

Samsø's Ecomuseum helps visitors explore the cultural history of the island and learn about the renewable energy island project. Cultural events with renewable energy as a central theme build on existing cultural traditions. Examples are the Wind Power Festival of Wildpoldsried, the Eco-Energy Land network showcasing regional produce, nature trails and the ecoenergy marathon in Güssing; and Samsø's Energy Safari conducted with the municipality of Skive. Boosting ecotourism also provides an added internal signal: to maintain renewable energy production to keep up with visitor expectations.

Small steps lead from valuing 'plain old information' to knowledge dissemination and public promotion, to learning through feedback and even the development of new intellectual capital. New research and development institutions are central in all three communities, established by, and answerable to, the local authority for the monitoring of existing projects and the guidance of future renewable energy development. In Güssing and Samsø, the role of such entities is extended to enable companies within the region to share and export their renewable energy technologies and expertise. The nurturing of knowledge networks—

research and development partnerships—was essential to the success of many established projects. Networks are manifest in three distinct types: the learning network, involving research institutions; the industry network, engaging private companies; and the political network, also among governmental entities. In our three communities, the combination of all three networks was present. Güssing for example took advantage of the structure set by the regional competence network, RENET, through a 'Competence Network for Energy and Biomass' linking industry, government and the community with educational institutions. Via RENET, Güssing was able to establish the world's first demonstration plant for the production of electricity and synthetic fuels using the Fischer–Tropsch process with the research and technical know-how provided by Vienna's Technical University and other industry partners. The RENET institution enables work to progress quickly, enhances knowledge development and provides funding. From here, new human resources are mobilized. The facilities in Güssing have themselves become laboratories, attracting various new research projects. The biomass plant, for example, helps conduct studies on the syntheses of methane, the operation of fuel cells and production of liquid fuels. Investigations into biofuel alternatives are underway in collaboration with Volkswagen, Daimler-Chrysler, Volvo, Renault, BP, EDF and other partners (RENEW).

2.4 Community Assets: From Public to Cooperative Ownership and Operation

The facilities owned, operated, managed and controlled by local government can also be readily available tools—from the urban infrastructure apparatus to the development of municipal buildings, streetlights, car fleets and undeveloped or underused property. Government has a higher degree of accountability and responsibility to do better—and certainly no worse—than the private sector. It can use its asset management, capital investment policy and practice to set a powerful example to the community. A typical example from our towns: Wildpoldsried and Güssing revised their own corporate standards, mandating renewable energy deployment in all municipal buildings for heating by installing full thermal insulation and better windows. Public land, intelligently used, can be a powerful change lever: in Samsø and Güssing, local authorities are able to control the price of renewable heating and electricity since biomass and biogas plants are owned and operated, either in part or entirely, by the local municipality.

But municipal assets also include institutional frameworks and organisations. To give an example: communities that own and operate power companies and other public utilities are considered fortunate; such institutions can be powerful agents in promoting renewable energy and efficiency policies, developing infrastructure and engaging in farsighted autonomy measures of all kind. Where no public power assets exist, these can be won back, or be newly acquired. They can

also be substituted through financial and organisational means, through new, special purpose incorporated entities, such as the various organisational innovations of our three municipalities described in this chapter.

Ownership and control are also critical among the local population—the primary participants in change. A range of forms and styles of control over renewable energy production, facilities management and operations is present in all three local authorities. In Wildpoldsried, the district heating system is owned and operated by the municipality through a private limited company, while the local citizens cooperatively or privately own wind turbines, four biogas plants, 90 photovoltaic systems and three hydroelectric power plants—all generating an excess of 2.8 times the total electricity consumption within the municipality. In Güssing, too, renewable energy installations contain a mixture of owner-investment types. Its facilities management and energy monitoring body (EEE Association), district heating network and renewable energy power plants, are largely owned and operated by private limited companies, with the municipality as the main stakeholder (51 %). In Samsø, community working groups established with the support of the local authority determined the composition of ownership of the various installations, from individual wind turbines and large-scale wind fields to the district heating system. The island's large heating plants, for instance, are in three forms of ownership: one owned and operated by a local utility company; another by a private investor; and the third is cooperatively controlled. The range of ownership types reflects the local authority's insistence that all projects benefit the entire community. When the Shell Oil Company sought to impose the condition of becoming the sole owner of a wind power project in Samsø, the proposal was resoundingly rejected.

Renewable energy plans are usually implemented through cooperatives, supported by local and outside companies as co-investors, under the management of the local community. All three cases exhibit operating entities established outside of local government, yet are owned wholly, or partially controlled by it: planning coordination was conducted by the local government-owned town cooperative in Wildpoldsried; the EEE Association and EEE managed private limited companies in Güssing; and the Samsø Energy Supply Company and later the Samsø Energy Company in Samsø.

The energy cooperation model required a reliable financial model to be provided by the local authorities, in order to ensure the funding of larger-scale renewable energy facilities. In Wildpoldsried, the local government's village energy cooperative coordinates and manages almost all projects. Güssing's business plan stipulates a continued assessment of markets, available energy sources, and an optimised mix of technologies, to offer credibility and security for making the business case for projects with 15 to 20-year horizons. This attracted and helped successfully secure long-term partners. In Samsø's financial model, the inevitable complexity of energy structures was acknowledged, but at its core it retained the principle that a high degree of local ownership should prevail, be evenly distributed and not concentrated within one company. Such essential economic frameworks would help strengthen regional energy user-supplier chains.

Ongoing information feedback, learning-through-monitoring and accountability are common features of all three cases. In Wildpoldsried, the energy management systems in place led to the greater understanding of local consumption and production levels. Participation in the European Energy Award Scheme® has meant the implementation of municipal energy policies, structuring processes and rules for monitoring, auditing, reporting and certification. At the council administration level, future plans and projects, their implementation and alternative funding models now rely on statistical evaluations of energy activities, including yields of photovoltaic systems and heat consumption values. In Güssing, progress in energy development research through the EEE Association has meant increased efficiencies in energy generation and management of their renewable energy plants. Meanwhile, monitoring and research activities conducted by the Samsø Energy Academy provide progressive reports to its local authority. These help assess existing energy standards as well as inform the formulation of future energy policies. In our three local authorities, all energy activities—including operations, management and research—are accountable and report to the mayor: in Wildpoldsried via its Village Heating Company and EZA; in Güssing via the EEE Association; and in Samsø via the Samsø Energy Academy and Samsø Energy Company.

2.5 New Plans and Planning Skills

Globally, the ground is shifting for local planning organisations and their tools. Mapping renewable energy capacity, understanding energy flows, realising which roof and open space assets are available for renewable electricity and thermal energy conversion: such knowledge forms the basis for achieving renewable energy independence in an efficiently structured and purposeful manner. By generating a full picture of all energy streams, their sources and sinks, the foundation for successful strategies is formed. And by mapping the potential of the local area according to its physical ability to generate renewable power based on its built form and spatial patterns, the stage can be set for building an energy-autonomous community that optimises its own local potential first (Genske et al. 2009).

These new tools and the planning scenarios they enable are a far cry from even recent climate governance practice in local planning. Many communities are engaged in target setting, as Eric Martinot has observed, aiming at a future amount of renewable electricity for local consumers; yields of renewable electricity for municipal operations and buildings; a percentage of biofuel use for publicly owned vehicles and for public transit; or CO_2 reduction targets, emulating, but also sometimes misunderstanding, the Kyoto processes of target setting. The limitations of these piecemeal efforts and fractional target setting exercises have become all too clear. Traditional local physical planning practice is being reformed: urban planning authorities regularly designate certain “green development” zones or infrastructure; anticipate electric vehicle infrastructure needs; engage renewable

energy in public infrastructure in some systematic way, for street lighting, traffic lights, for example, or other infrastructures (Martinot 2009).

By contrast, in our three towns, energy plans lie at the heart of practice: the integrated energy plan—"Wildpoldsried Innovativ Richtungsweisend WIR" ('innovative, direction setting'—'WE'), the "Kreislauforienteierte Bedarfsdeckung" ('cyclical satisfaction of need') energy-cycle plan of Güssing, and the Renewable Energy Island plan of Samsø. Common to all is the order of priorities: to save energy and increase efficiency; expand the collective heating supply systems fuelled with renewable energy; expand individual heating systems; establish renewable energy facilities for energy production; and gradually convert the transport sector from petrol and oil to renewable electricity.

Plans were based on a similar resource analysis methodology: first, to ascertain the energy demand and availability of necessary land for energy crops and the like; second, to identify suitable technologies and develop energy supply scenarios for the district; third, to calculate the potential for emissions reduction; and, fourth, to perform cost/benefit analyses and develop an appropriate financing model. These plans formed the basis for the standards that were set in each of the local government's energy plans, with all models being based on the provision of heat, fuel and electrical power with renewable sources, in that order. All were focused on energy conservation, renewable energy generation, value creation and environmental protection. All planning projects mandate the support and diffusion of two main areas: first, large-scale renewable energy infrastructure planning and construction for bioenergy plants, district heating networks, solar fields and wind power plants; and, second, the diffusion of small-scale renewable energy systems—individual photovoltaic systems, biomass pellet heating systems; and local heat pumps installed by households.

The development of staff skills is essential for an aspiring and practicing energy-autonomous community. Wildpoldsried provides energy-relevant and targeted training programmes for municipal employees. Güssing operates the EEE association to run programmes to train energy managers who will be responsible for villages and towns in the greater Güssing region. The EEE association not only coordinates all demonstration plants, projects and research, but also programmes for further education in this field. Through the Association, the municipality hosts a team of highly trained technicians and international scientists, working to develop innovative technologies, solutions and patents. Extending this push into a burgeoning service industry, it has created teaching facilities for training solar technology installation technicians besides its municipal energy managers. Its solar school programme (Solarteur®) provides operational training for teachers, and runs a programme for secondary school students, teaching renewable energy practices and technical skills, such as the use of heat pumps, solar cells and solar panels. It includes practical workshops and site inspections of facilities. This learning programme now operates throughout Europe. Similarly, the Samsø Energy Academy functions as a meeting place and laboratory where the community can discuss and learn about energy and local development. Like the EEE Association, it also conducts research, organises workshops, conferences and

exhibitions and run training programs for primary and secondary school children. Educational programs teach energy concepts by conducting hands-on experiments with energy in a variety of forms such as building models of wind turbines or electric motors. (PlanEnergi and Samsø Energy Academy 2007)

2.6 Augmenting Energy Autonomy with Ecological Regeneration

The energy plans of all three local authorities are embedded in or linked to other ecological aims and agendas. In Wildpoldsried, an ecological learning centre assisted the community in the establishment of their own wetlands, known as the "WiWALaMoor", a project funded by the European Union and the Free State of Bavaria as part of the LEADER+ programme. The wetlands concept is based on encouraging local rainwater retention and filtration measures, creating ponds as natural swimming pools for sport and recreation. Ecological cycles are supported by the creation of open meadow orchards, nature trails and an ecological treatment facility to convert sewage sludge into humus. In Güssing, the promotion of eco-tourism is based on renewable energy production and environmental preservation. Established nature and energy trails through the regional vineyards showcase local produce alongside local energy production. Samsø's original renewable energy plan envisioned lowered greenhouse gas emissions and improved local water systems by outlining a methane plant to extract energy from animal slurry and waste from agricultural processes, alongside planting projects of localised willow beds to clean low-nutrient wastewater. Although these plans have not come into fruition, the focus has not been entirely abandoned: smaller-scale biogas capture projects based on local farms have been highly successful.

3 Conclusion and Outlook

Communities cyclically using local resources can ensure a secure supply of energy, enhancing local prosperity and resilience, innovation and sustainable growth. In our three communities, citizens organised themselves to adopt a life-style based on renewable energy, fostered and supported by local authority and legislative frameworks. Community involvement, public–private partnership and powerful research support coupled with strong regional commitment were fundamental to achieving common energy goals. Because the energy supply cycle is of common local interest, political disputes proved rare. To make the local energy supply cycle work, it seemed essential to form organisations distinct from the core structure of the municipality whilst maintaining strong relations and cooperative agendas with it. The examples of these three local municipalities show that this

leads to rapid development, strong innovation impulses and the broad uptake of fresh ideas on local renewable energy. And by establishing research and development bodies, local authorities became learning organisations, dynamically understanding the evolution of facilities and policies, constantly advising on necessary policy reforms, as supported by original research.

We showed that even small and seemingly less powerful communities can control their destiny in climate change governance. Setting a precedence for further research, small communities may well have something to teach even larger cities: communities of limited size, neighbourhood organisations, identifiable districts and their governance matter. Smaller communities may find it easier to become energy autonomous more quickly: a small group size makes it easier to find common ground and to reach an agreement. Having explored the world of small communities from its institutional capacity for effective climate change governance, we look forward to studying the impact of local renewable energy autonomy as a core feature of climate change governance on the organisation of large cities and metropolitan regions.

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